Understanding Special Relativity

SAYAK SAMANTA

Imagine, you are Standing on a road and Einstein, is in a car coming towards you. Or you thought. Einstein says that the car is stationary and the road is moving. Well, it would be very obvious that Einstein is moving because of the bumpy roads we have, but in this example, we are only talking about 'special' cases where the road is flat and we are traveling at constant velocity. This is where the word special comes from in Special Relativity. Now, how do we prove that it is Einstein who is moving? We ask Einstein to throw a ball up and it should Land behind him, that is if he is moving. But the ball lands back in his car when we do this experiment. But how is this possible? It is because, before the ball was thrown up, it was moving with the car, and when we threw it up it kept its Momentum due to inertia. Ok, let's try something else. This time we fire a bullet (Toy Gun) from the car. The bullet should be moving slightly slower (From Einstein's view) since Einstein is moving. OK, so let's try this experiment. But once again due to inertia, the bullet would go the same speed from Einstein's view. From our perspective, the bullet would go slightly faster because it would carry the velocity of the car with the normal speed of a bullet. This is yet again debatable, so it doesn't prove anything. Now, Inertia is the reason for these experiments not proving anything. How about using Waves? Inertia is a property of Mass. Waves don't have mass. Let's try a new experiment. We ask Einstein to use a sound gun and fire it from his car. Since the speed of sound is constant, when Einstein fires his sound gun he should observe the speed of sound to be less. That is If he is moving. Now when we try this, we can see that, yes it works. Now Einstein has nothing to say. But Einstein argues that the wind is causing the speed of Speed Sound to be less. How is this possible? Because sound requires a Medium and that medium's Speed can vary. Sound needs a medium which is air, so if the direction of the air is against the Sound. We would 'perceive' the speed of sound to be less. This is known as the escalator effect. When you go up an escalator but the escalator is going down you just stay there, because both the forces balance out. So, what can we do? Let me Introduce to you Electromagnetic Waves! Electromagnetic waves don't REQUIRE A MEDIUM, Examples are, Light, Radio waves, and X-rays. This Time the experiment has to

work. We ask Einstein to turn on his headlights. Einstein should observe the speed of Light to be less and he Can not use the escalator effect (Because light doesn't need a medium). But when we try this einstein observes the speed of Light to be the same. How in physics is this entirely possible?? The only logical conclusion is that you are moving and not Einstein. If you try this experiment from your perspective, the speed of Light is also the Same. Einstein and You observe the speed of Light to be the Same even though one of you is moving. This is due to Length Contraction. Take for example a universe where the Speed of Light is 100km/s and we are traveling at 90km/s. Since Speed = Distance/Time, we would observe (In 1 second) that the speed of Light is equal to 10km/s. The Speed of light is the same for all Observers, if then how is it possible that we observe it at 10km/s? The answer is we don't. Think about it, what do I need to do to make the speed of light observed at 100km/s? Let's look at the equation- Speed = distance/time. We saw light to be traveling at 10km/s which is- 10km/1 second (distance/time). What do we need to do to make the speed of light = 100km/s? It's very simple but Confusing. Decrease denominator. If we decrease the denominator the value of the fraction increases, making the speed of light = 100km/s. This is The Answer. You may be asking, but the denominator is time, how is it possible time decreases if we measure this in 1 second? Well, to us it appeared to be 1 second but to someone stationary, it was less than 1 second. This means that not everybody's time is the same. This is Time Dilation and measuring the speed of light to be the same for all observers was Length Contraction. This is How Albert Einstein came up with The Theory of Relativity, the most influential scientific paper of all Time.